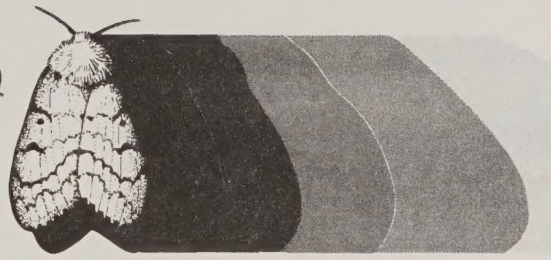
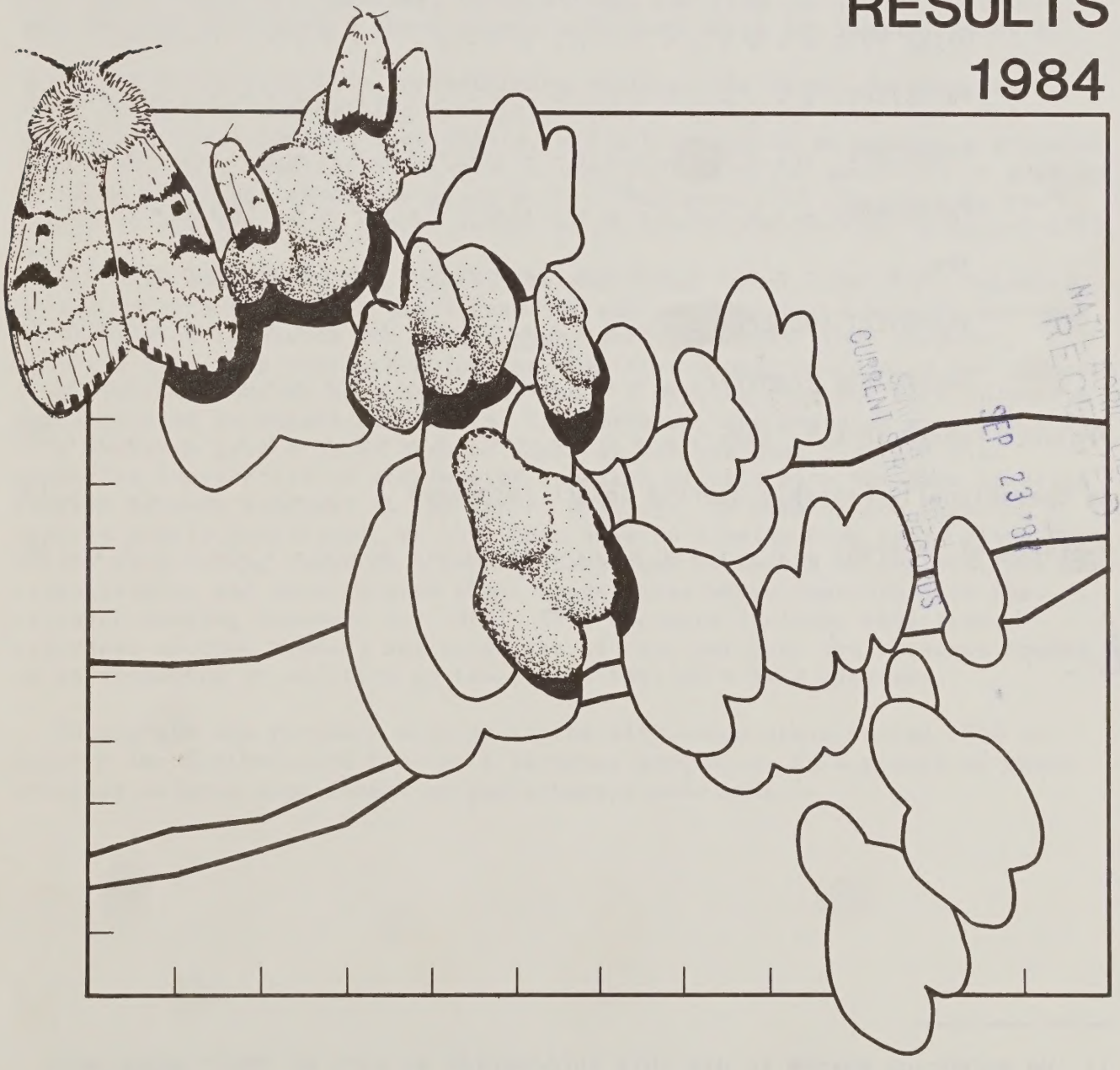


September 1985
Number 10

GYPSY MOTH NEWS

370 REED ROAD, BROOMALL, PA 19008
U.S.D.A., FOREST SERVICE

RESEARCH RESULTS 1984



GYPSY MOTH RESEARCH ACCOMPLISHMENTS[1/]

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1/ We encourage anyone to use this information as part of their gypsy moth education program.

Cover: Courtesy of Jim Lockyer, USFS, Broomall, PA.

RESEARCH ACCOMPLISHMENTS--1984

The research planning process for management of the gypsy moth has been moving at an accelerated rate since 1982. This planning process has involved the USDA's Forest Service, Agriculture Research Service, and Animal and Plant Health Inspection Service, many univesities, industry representatives, and state agencies. The planning leading this report was initiated in the winter of 1982 by discussions between Denver Burns of the Forest Service and Charles Pitts of the Pennsylvania State University. This discussion resulted in a brainstorming meeting at Pennsylvania State University by scientists from many government and state agencies, universities, and from the private sector. This meeting generated a short report with many ideas for future research.

Concurrently with this brainstorming meeting, the Forest Service was negotiating with a modelling firm to conduct a series of workshops with scientists, pest control specialists, and policy makers to produce a document that would help identify and evaluate important research questions or gaps in existing knowledge about the gypsy moth. This aspect of the planning was completed and the final report submitted to the Forest Service in August 1983.

With the aid of the PSU report, the modelling report, and other internal Forest Service reports, a small team met and put together a working document to serve as a framework for future gypsy moth research. This document, composed of severn research objectives has been widely circulated and comments from numerous sources have been received. A writing team for each objective was appointed to expand and modify, if necessary, the research plan for 1984. This approach gave a broad base of ideas in the research plan and slso prevented duplication of accelerated research efforts with the base research program already underway in the Forest Service. By keeping the planning efforts widely publicized, we have been able to develop long range plans that builds on existing research efforts. Each team contacted scientists from many organizations and incorporated their suggestions where feasible into the research working document for 1984. This document included objectives, estimates of time needed, and estimates of cost per year for research needed to be conducted in addition to the Forest Service's base program.

Thirty-six new projects were initiated with cooperators during 1984 to support the Northeastern Station's in-house projects. As a result of these combined efforts significant accomplishments were made.

GYPSY MOTH RESEARCH UPDATE * JULY 1985

Accomplishments are summarized by objectives for the first year of the Northeastern Forest Experiment Station/university cooperative gypsy moth research program.

The Program goal is to obtain the knowledge necessary to manage gypsy moth populations so that outbreaks occur less frequently or are prevented. The research objectives are:

1. Determine the effects of gypsy moth on forests.
2. Improve the understanding of the biology and population dynamics of gypsy moth.
3. Develop the means to utilize parasites as regulators in low level gypsy moth populations.
4. Determine the role of invertebrate and vertebrate predators in low level gypsy moth populations.
5. Determine the role of selected pathogens and develop technology to utilize them as regulators in low to medium gypsy moth populations.
6. Evaluate role of integrated pest management (IPM) for gypsy moth.
7. Develop scientific technical support for gypsy moth research.

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* For additional information, contact Program Manager for Gypsy Moth Research, NE Forest Experiment Station, 370 Reed Road, Broomall, PA 19008

1. FORESTS

Research on the effects of gypsy moth on forests is centered around three areas: the impact on forest stands including both growth loss and mortality, understanding the mechanisms involved in the mortality process, and silvicultural treatments for minimizing impacts. (Cooperators: NE Area State & Private Forestry; West Virginia Univ.; Penn State Univ.)

* The impacts of gypsy moth on 600 plots (established by Forest Pest Management) in central Pennsylvania have been monitored and hazard rating guidelines are under development.
* Long-term plots to examine the effects of different silvicultural treatments on gypsy moth impacts were established at one site.
* Site and stand conditions that influence mortality and growth loss are being examined in the Ridge and Valley area of eastern West Virginia in areas that were defoliated by a looper complex and are now being invaded by gypsy moth. Undefoliated stands had 4% of basal area dead,

defoliated plots had 35%. Oaks lost 50% of basal area in defoliated plots. There was greater mortality on better sites.

* Site and stand conditions that influence mortality and growth loss are being examined in the Appalachian Plateau province of Pennsylvania and West Virginia in areas that are just now being invaded by gypsy moth.

* Biodeterioration of oak trees that have died following gypsy moth defoliation has resulted in a 17% loss in volume after 6 years. Amount of degradation by fungi and insects is slight during first growing season after death.

* Studies are underway to determine the influence of defoliation on foliage quality and the changes in foliage quality on gypsy moth growth, development, and fecundity. The data set is the most detailed and extensive leaf chemistry data set for any natural stand of trees. Preliminary analyses indicate that growth and fecundity decrease with increasing levels of defoliation. There were no strong relationships with specific leaf chemicals, but overall leaf buffering capacity may affect, not only growth, but susceptibility to viral or bacterial infection.

* Sites historically resistant or susceptible to GM were shown to differ in foliage quality. Two factors characteristic of susceptible sites, minimal inter-intra tree shading of foliage and soil moisture deficits were shown to result in higher foliage quality for caterpillars.

* Cottonwood is a poor host for GM in early spring but larger larval were found to grow better on mature cottonwood foliage than on oak foliage. Old, slow growing cottonwood was more susceptible than juvenile trees.

2. GYPSY MOTH

Population dynamics research is addressing several crucial areas. Studies undertaken include sampling gypsy moth, determining meteorological parameters of its forest environment and clarifying the existence and/or role that forest sites susceptible to defoliation play in area-wide outbreaks. The following results were obtained from a number of cooperative research studies at sites in Vermont, Connecticut, Massachusetts, New York, Maryland and Virginia. (Cooperators: Univ. Conn.; Univ. Vermont; Univ. Mass.; Univ. Maryland; Cary Arboretum; VPI and SU.)

* Developed and deployed a sampling grid of 15 m^2 dia plots in which gypsy moth densities (egg masses, larvae and pupae) are being determined relative to forest physiograpy. Larval populations corresponded to egg mass densities; stands susceptible to gypsy moth defoliation appeared to have higher densities of larvae in the canopy as well as under burlap bands than adjacent resistant stands.

* Burlap bands attract late instar larvae from nearby unbanded trees. Timing of band deployment influenced larval numbers under them; destruction of silk trails did not influence numbers of larvae under

bands. A model describing larval movement and partitioning within 15 m^2 dia plots was developed and will be used to test data from other plots.

* Pyrethrin knockdown of gypsy moth larvae in canopies was compared with those marked with acrylic paint is being used to initial larval densities per tree by host and to evaluate densities of instar IV-VI under bands deployed in area plots in four states. A regression equation predictor has been developed and is being tested as a means to relate total larval density with those found beneath burlap bands.

* A forest airflow meteorological model based upon stand geometry has been developed. Temperature, radiation and humidity are being added. It will be validated using meteorological data obtained from towers erected in the Vermont sites.

* An energy budget model has been constructed that is the precursor of a climate-space model for gypsy moth. It will be interfaced with the stand meteorological model to evaluate how changes in stand geometry, density, etc. could be used to influence gypsy moth behavior and survival.

* The abundance and species of other invertebrates collected in the process of sampling gypsy moth larvae with pyrethrin sprays are being identified and quantified. Such information will be used to assess their potential as alternate or primary hosts for predators, parasites and diseases.

3. PARASITES

Research on parasitism of the gypsy moth was directed toward understanding the actual impact parasites have on gypsy moths on a generational basis, and in particular, the role of parasitism in low density gypsy moth populations. In addition, studies were conducted to determine the chemical and behavioral basis of host selection, and in the development of methods for rearing, biological evaluation, and establishment of exotic parasitoids. (Cooperators: Univ. Mass.; Univ. Maryland; Univ. Vermont)

* Recoveries of marked larvae yielded important information on the level of parasitoid input independent of the compensatory action of other mortality factors. By combining the measured input with the weekly estimated host density, estimates could be made of stage specific "generational" mortality caused by any particular parasite.

* The studies using marked larvae also provide information that helps identify the most appropriate moments in the generation for which to obtain estimates of parasitoid impact. For example, at what physioligical age of the host can percent parasitism be used to estimate the actual impact on the gypsy moth population.

* Laboratory studies indicated that Cotesia melanoscelus could potentially cause higher levels of mortality in gypsy moth populations than would be indicated by determining rates of parasitization alone. Total mortality due to parasite attack was significantly higher than the classical rate of parasitism; i.e., percent parasitism as determined by emergence of the parasite from the host. Total mortality increased significantly with number of attacks per host.

* Seven methods were tested for collecting gypsy moth larvae in low level populations. Early stage larvae utilized branch bands for resting sites and thus could be used for collecting larvae. This will be particularly useful in low density populations, and where search in the crown of large trees is limited by accessibility and time.

* Results of studies to investigate the host selection behavior of Ooencyrtus kuvanae, an egg parasite of the gypsy moth, suggest that the parasite is unlikely to be effective when egg masses are primarily deposited in dark, hidden areas, a condition typical when gypsy moth population density is low. In the laboratory, parasites are attracted to egg masses located in both light and dark chambers. However, they appear to be inhibited from entering the dark chamber, aggregating instead outside the chamber.

* Laboratory studies of Rogas lymantriae show that sex ratio of this parasite can be manipulated by changing the density of the host relative to density of parasite females. This is important for understanding parasite viability at various gypsy moth population densities, and in developing protocols for mass rearing. In addition, the R. lymantriae was released for establishment in two sites in Vermont and in Maryland Gypsy Moth IPM area.

* Three thousand Blepharipa pratensis puparia were reared/collected for mass rearing and experimentation in FY 1985.

4. PREDATORS

Recent emphasis on management of gypsy moth populations has shifted from crisis management toward IPM. This necessitates an understanding of the role of predators in low level populations. Current research is approaching this problem through (1) an evaluation of gypsy moth mortality caused by vertebrate and invertebrate predator species (including searching behavior and effects of alternative foods on predation rate), (2) an understanding of the interactive relationships between predators and other natural enemies of the gypsy moth and (3) the feasibility of manipulation of predator populations and habitat to enhance predation impact. (Cooperators: Penn State Univ.; Univ. West Virginia; Dartmouth College).

* Studies in Vermont have shown that predator diversity and density are reduced in susceptible forests.

* Gypsy moth comprised approximately 6% of the summer diet of Peromyscus leucopus in a Vermont study. Thus suggests that many gypsy moth are eaten in spite of the availability of more preferred food and that opportunities and varied diets are characteristic of this important predator.

* Frequency of occurrence of gypsy moth in the stomachs of 557 birds of 17 species revealed 88% of the species and 24% of the individuals ate gypsy moth.

* Invertebrate predation of pupae found to be much more important than previously thought. Invertebrate predation accounted for nearly 50% of the measured predation.

* A study of four species of warblers suggested that the inherent propensity of a particular species to attack gypsy moth is related to its foraging guild. This observation supports the hypothesis that movement by larvae away from the canopy may have been in part a response to avoid natural enemies.

* Among 13 genera of carabids tested, 27 of 35 species gave a positive ELISA reaction indicating that they had eaten gypsy moth.

* Eight breeding bird censuses were completed in Pennsylvania hardwood forests that represented different cover types and topographical areas yielding important predator diversity and site susceptibility (to gypsy moth) information.

* Densities and species of avian and small mammal predators were ascertained in the four study sites and interpreted on the basis of forest physiography. Small mammal populations showed few differences but for the 60 species of birds, habitat preferences exist.

5. PATHOGENS

Heretofore, minimal emphasis has been placed on understanding the role of pathogens as regulators in low to medium gypsy moth populations and subsequently developing the technology necessary to utilize them in this regard. This is now being approached through (1) an evaluation of selected pathogens, e.g., NPV, strains of Bacillus thuringiensis and protozoa, as either natural or artificially introduced regulators in static or pre-outbreak gypsy moth populations and (2) developing and evaluating formulation-application systems appropriate for the introduction of these agents into such populations. (Cooperators: Univ. California; Ill. Natural History Survey; Univ. Maryland; Univ. Mass.; Penn State Univ.; NE Area State & Private Forestry)

* NPV dynamics studies in pre- and post-outbreak gypsy moth populations have provided data to support the hypothesis of a first and second "wave" of NPV mortality even at low population densities. In these studies an enzyme linked immunosorbant assay was used to predict NPV mortality with reasonable accuracy.

* The ELISA technique was used to detect and quantify NPV in 10,000 samples.

* Monoclonal antibodies specific to both NPV polyhedral and nucleocapsid protein have been produced. This makes available a highly specific NPV detection tool for use in environmental and pathological studies.

* The pathways of NPV infection at the cellular level have been intensively studied and are now reasonably defined.

* A more effective strain of Bacillus thuringiensis, NRD-12, has been developed and is now commercially registered for use.

* Two nematode species have been laboratory and field tested against gypsy moth larvae. Results are promising, but further research, aimed at promoting menatode survival in the field are necessary.

* Aerial sampling techniques for evaluating within-canopy microbial spray deposits have been developed. Lateral distribution widths have been developed for small fixed winged aircraft using two commercial Bt preparations and two nozzle systems.

6. INTEGRATED PEST MANAGEMENT

Cooperative studies within the objective are designed to develop the technology to manage the gypsy moth at population levels below that causing visible damage and subsequent impact. This implies that we can prescribe (1) a monitoring system that indicates changes in trend of low to moderate density populations, (2) a decision making process for users, and (3) environmentally sound tactics to address populations within a range of densities. Much of this research is complementary to or in collaboration with the Maryland Gypsy Moth IPM Project

that is being supported by the Northeastern Area State and Private Forestry. A Forest/Gypsy Moth Life System Model continues to updated and tested.(Cooperators: APHIS; Maryland Dep. Agric.; Univ. Maryland; State Univ. N.Y.; VPI & SU; Univ. Mass.; Penn State)

* Releases of sterile eggs were made into two plots within the Maryland IPM project area. Daily monitoring and weekly sampling were conducted to determine synchrony of hatch and development with the native population. Egg masses were collected and will be tested early in 1985 to evaluate the efficacy of the release.

* A cytological procedure has been developed whereby the sterility of F_1 larvae can be determined by measuring the occurrence of chromosome translocations. This will eliminate the time-consuming procedure of rearing and mating progeny with feral individuals in order to assess their sterility.

* Analysis of historical defoliation records from Massachusetts and New Hampshire indicate that a number of suspect focal sites (areas where outbreaks occur frequently and from which populations may emanate) do exist. Patterns of defoliation are being examined to determine if outbreaks do expand from these sites.

* A series of 9 ha. plots were established in Massachusetts, Pennsylvania Maryland and Virginia to monitor changes in gypsy moth densities and to determine the utility of deploying a systematic grid of male moth traps and burlapped trees to assess gypsy moth densities.

* Extensive testing was completed to develop a pheromone-baited trap that would be sensitive at endemic population levels but that would not become saturated when populations are moderate to dense. New prototype traps are being evaluated.

* Experiments conducted in Massachusetts and Connecticut indicate that a larger number of gypsy moth late instars congregate under burlap than under plastic flaps on adjacent trees of the same species and diameter. Based on this and estimated cost per unit of sample, burlap is the preferred device for monitoring larval and pupal populations.

* Began converting the Gypsy Moth Life System Model to standard FORTRAN.

* Initiated planning of management-oriented forest-gypsy moth decision support system.

7. TECHNICAL SUPPORT

Technical support provides materials and tools that facilitate research in the other six major target areas. One aspect focuses on rearing high quality gypsy moths and some of its parasites.(Cooperator: APHIS)

* Provided various stages of two different strains of laboratory-reared gypsy moths to Forest Service and university scientists.

* Maintained stock colonies of three gypsy moth parasites for research purposes.

* Produced about 700,000 egg masses for 1985 field testing of the gypsy moth inherited sterility technique.

TECHNOLOGY TRANSFER

A technology transfer plan has been prepared by the Northeastern Area State and Private Forestry, Region 8, and the Northeastern Forest Experiment Station. This plan will assure that the latest research findings are delivered to potential users as soon as possible. A copy of the plan can be obtained from Forest Pest Management, 370 Reed Rd, Broomall, PA 19008.

The following projects were funded in 1985. The selection was made after a comprehensive research review held at Windsor Locks, CT January 29-31

NORTHEASTERN FOREST EXPERIMENT STATION

COOPERATIVE GYPSY MOTH RESEARCH-FY1985

Investigator (Institution)		Project Duration and Number
	Objective 1--Forests	
Ray Hicks (WVU)	Determining mortality functions for gypsy moth defoliated stands in the Appalachian Plateau.	5/6/85--5/6/86 23-962
Bill Merrill (Penn State)	Biodeterioration of oaks killed by gypsy moth defoliation.	8/14/85--6/14/85 23-004
	Objective 2--Gypsy Moth	
Bruce Parker (UVT)	Biological processes influencing gypsy moth populations in susceptible and adjacent resistant forests.	4/1/85--4/1/86 23-971
Dave Miller (UConn)	Quantification and prediction of the gypsy moth (*Lymantria dispar* L.) habitats.	4/15/85--6/30/86 23-965
Jack Schultz (Penn State)	Sources of variable foliage quality and its impact on gypsy moth performance.	5/1/85--5/1/86 23-974
Clive Jones (Cary)	Quantifying habitat--differentiated gypsy moth population dynamics at low densities.	4/15/85--4/15/86 23-973
Ted Taigen (UConn)	A climate space-energy budget model of gypsy moth (*Lymantria dispar* L.) caterpillars.	5/1/85--5/1/86 23-982
Pat Michaels (UVA)	Estimation of the climatic component of gypsy moth outbreak and spread over large areas with multivariate statistical methods.	8/15/85--8/15/86 23-005
	Objective 3--Parasites	
Joe Elkinton (UMass)	Developing sampling techniques for gypsy moth parasitoids	4/15/85--4/15/86 23-968
Mike Raupp (UMD)	Determination of incidental gypsy moth mortality caused by the parasitoids *Cotesia melanoscelus* and *Blepharipa pratensis*.	4/1/85--5/1/86 23-966

Objective 4--Predators

Bob Whitmore (WVU)	Vertebrate predator and gypsy moth population interactions and their influence on defoliation.	4/30/85--4/30/86 23-972
Noble Proctor (S.Conn)	Effect of alternate food manipulation and silvicultural techniques for enhancement of avain predation by gypsy moth.	5/1/85--5/15/86 23-975
Lee Stribling (Penn State)	Effect of forest thinnings and salvage on gypsy moth predator populations.	5/1/85--5/1/86 23-981

Objective 5--Pathogens

Alan Wood (Boyce Thompson)	Persistent gypsy moth nucleopolyhedrosis virus infections.	4/15/85--4/15/86 23-963
Joe Elkinton (UMass)	Nucleopolyhedrosis virus dynamics in gypsy moth population.	4/15/85--4/15/86 23-969
Harry Kaya (UCA)	Biological control of the gypsy moth with the entomogenous nematode, Neoaplectana carprocapsae.	4/15/85--4/15/86 23-987
Bill Yendol (Penn State)	A continued study to determine spray distribution, effectiveness, and longevity of microbials used against gypsy moth in the protection of eastern forests.	5/1/85--6/1/86 23-994

Objective 6--IPM

Ring Carde (UMass)	Development of a monitoring trap for sampling adult gypsy moth males.	4/15/85--4/14/86 23-970
Joe Elkinton (UMass)	Determining optimal burlap sample criteria and a spatial analysis of gypsy moth egg mass counts and pheromone trap catch	4/15/85--4/14/86 23-967
Joe Elkinton (UMass)	Development of a gypsy moth population monitoring system.	11/1/84--11/15/85 23-936
Bob Tichenor, Jr. (MD Dept.Agr)	Conduct and evaluate a pilot test to suppress gypsy moth populations in the Maryland gypsy moth IPM area, using releases of F-1 sterile eggs.	5/1/85--5/1/86 23-978
Bruce Parker (UVT)	Use of inherited sterility for suppressing low density gypsy moth populations in Vermont.	5/1/85--5/1/86 23-985

Bill Ravlin (VPI & SU)	Development of a gypsy moth population monitoring system.	5/1/85--5/1/86 23-986
Chuck Schwalbe (APHIS)	Development and evaluation of gypsy moth inherited sterility technique.	5/1/85--9/30/85 23-585
Karen Wilson (NC Dept.Agr)	Assistance in analyzing and refining the gypsy moth life system model.	8/15/85--8/14/86 23-006

Objective 7--Technical Support

Chuck Schwalbe (APHIS)	Produce eggs for 1986 application of gypsy moth inherited sterility technique.	5/1/85--9/30/85 23-585
Tom ODell (USFS)	Quality control of reared insects.	5/1/85--9/30/85

One of the most intriguing advances in gypsy moth research has been the development of a technique known as - sterile release. GM News presents, here, a closer look at this potentially useful method(s) of gypsy moth population management.

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An Operationally Feasible Sterile Insect Technique

V. C. Mastro
C. P. Schwalbe
T. ODell

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Mr. Mastro and Dr. Schwalbe are with the USDA Animal and Plant Health Inspection Service (APHIS) Otis Methods Dev. Cntr., Otis Air Base, Mass. 02542. (617-563-9303)
Mr. ODell is with the USDA Forest Service, Hamden, CT.

The sterile insect technique has been used successfully for suppressing or eliminating populations of a number of insect species. In classical useage, large numbers of totally sterile insects are released to mate with members of a target (wild) population. When there is a high overflooding ratio of sterile:wild individuals and the sterile insects are competitive, mating of wild fertile insects will decline and suppression or, eradication can result. This technique is much more species-specific than most of the conventional management strategies - a release of sterile insects has very little impact on the environment and virtually no direct effect on such nontarget organisms as parasites and predators. Also, it does not allow for "refugia" that can harbor residual populations of the pest species, and the effects of repeated releases tend to be cumulative. Thus, the sterile insect technique is exceptionally well-suited for the eradication of isolated insect populations, especially when they occur in environmentally sensitive areas.

For the gypsy moth, evaluation of the "totally" sterile male technique began in 1977 and culminated in the successful eradication of an isolated population in Michigan. This trial demonstrated the competitiveness of the released sterile insect and the biological feasibility of using the technique; however, application costs were high compared to conventional eradication technology. Further, the technique was hindered by the limited production capacity of the existing rearing facility, combined with the fact that gypsy moth pupae (the stage that is released in the field) cannot be "stockpiled" to augment individual releases.

The phenomenon of inherited sterility provides a potential means of enhancing the efficiency of a sterile insect release program. When insects are treated with a substerilizing dose of radiation, a portion of their eggs will hatch and develop relatively normally. In the Lepidoptera, it is frequently possible to identify substerilizing doses that cause complete sterility among those surviving F-1 progeny. In 1981, irradiation studies were initiated to examine the

feasibility of using induced inherited sterility against the gypsy moth. The resulting data identified several irradiation schemes (radiation dose and age of pupae at treatment) which maximize the yield of F-1 individuals (40-60% of normal) while maintaining sterility in the F-1 generation. Thus, one "substerile" laboratory-reared male can sire many F-1 offspring. A release of substerile males will have a greater cumulative effect than the release of an equal number of totally sterile males since a population of fully sterile individuals will "naturally" occur in the next generation.

In initial laboratory and field studies, sterile F-1 males proved to be competitive with their wild-type counterparts, and sterile F-1 females appeared to be as attractive as wild-type females. Further, when F-1 larvae were reared on foliage, their survival and development (although not identical with those of wild-type insects) were adequate for a high degree of competitiveness. In 1982 in South Carolina, a release of substerile P-1 male gypsy moths constituted the first pilot-scale test of induced-inherited sterility in any insect system. This release resulted in the occurance of sterile F-1 individuals in the field the following year. There was no evidence of a remaining population in 1984 or 1985. In 1983, a second trial was initiated in Maryland; results of this test are also promising and show that sterile F-1 individuals can be found in the field the year after a substerile P-1 release.

Although the release of sub-sterile adults offers many advantages, application costs are still high (pupae must be released daily) and production cannot be stockpiled. To alleviate these problems, sub-sterile males were crossed with normal females in the laboratory and the resultant eggs (which develop into sterile F-1's) were released. Presently, eggs can be stockpiled for one-hundred days without compromising hatch synchrony or viability. As the gypsy moth's embryogenisis, diapause and post-diapause development become better understood, doubling of this stockpiling period should be possible. With an egg release, application costs are significantly reduced because sterile F-1 eggs need to be released only one day per year at any given site (contrasted with daily release of fragile pupae). The cost of applying eggs can be futher reduced by aerial release, which did not adversely affect eggs in initial field studies. F-1 progeny develop from eggs under the same field conditions as their wild conterparts - this will tend to synchronize the sterile adults, both developmentally and behaviorally, with the target population. The use of induced inherited sterility also will encourage populations of natural enemies, an advantage which will be most beneficial within the generally infested area or along the leading edge.

In 1984, the first pilot-scale release of sterile F-1 egg masses was conducted in Maryland. Results of this release, although far from final, are encouraging. It appears that development of F-1 larvae was in synchrony with that of wild-type larvae, and F-1 survival was adequate. Other laboratory and field studies also indicate that induced inherited sterility is a viable option for the treatment of

isolated infestations. In 1985, egg releases were made in Darke Co., Ohio and Whatcom Co., Washington in attempts to use this technique for eradicating isolated infestations there. Overflooding ratios (measured in larval and pupal stages) were observed to be nearly identical to those predicted (40 sterile:1 fertile) and other evaluations and observations are very encouraging. Releases were also made in Maryland and Vermont; those trials were aimed at assessing the approach for keeping native populations at low levels. Again, those studies are providing useful and encouraging information.

In all, the F-1 sterile technique offers a highly selective, environmentally safe and flexible alternative for treating gypsy moth populations introduced into new areas. As the technique is developed and deployed more widely, additional uses undoubtbly will be developed. These may include suppression along the leading edge, protection in high regulatory risk or high value areas, and suppression of gypsy moth population foci within the generally infested area.

It is obvious that induced sterility has the potential to increase the efficiency of sterile insect release programs. Notwithstanding, the limitations of the existing gypsy moth rearing facility(at Otis Methods Development Center) currently preclude the extensive use of broadscale testing of F-1 sterility. A large-scale mass rearing facility is essential for the full development and operational use of this technique.

Meetings of Interest

October 2-3 — *Bacillus thuringiensis* Workshop
Otis Methods Development Center
Otis Air National Guard Base, MA 02542
Contact: Win McLane
617-563-9303

November 5 — Understanding the Gypsy Moth Threat - An Information Symposium
Robson Square Media Centre
Vancouver, B.C.
Contact: R. F. DeBoo
604-387-5965

November 19-21 — National Gypsy Moth Review
University Hilton Inn
Columbus, Ohio 43202
Contact: Richard E. Barth or
Lawrence J. Ehlers
614-866-6361